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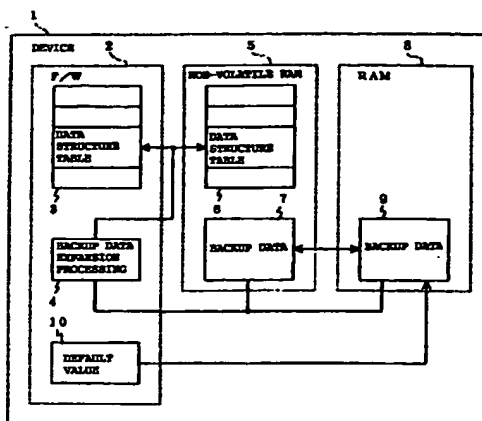
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(54) Device and method for backing up internal information and storage medium having internal information backup control program stored thereon

(57) The invention provides an internal information backing up device by which, even if the information is changed or the memory allocation is changed by version-up of a firmware, the data structures of the informations can be corrected automatically. When a firmware in which the form of backup data is changed is started, a backup data expansion processing element expands, based on stored contents of a data structure table, all labels of data structures into a RAM using default values of a default value storage element. The backup data expansion processing element compares a version of the data structure table of the firmware and a version of a data structure table in a non-volatile RAM with each other. If they coincide with each other, the backup data expansion processing element expands the backup data of a backup data element into the RAM, but if the versions do not coincide, the backup data expansion processing element maintains the default value.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an internal information backing up device and method as well as a storage medium having an internal information backup control program stored thereon, and more particularly to a backup of information for operating a firmware in a device into which a firmware is incorporated.

2. Description of the Related Art

Conventionally, in a device, into which a firmware is incorporated, for backing up information for operation of the firmware, the backing-up has been performed using a binary data form (information set in device) equivalent to information form in the device.

That is, information for operation of a firmware is held, as it is, in the same condition as the condition in which they were expanded into a RAM (random access memory) or a like element upon starting of the apparatus, that is, in such a condition that information having the same data structures is stored in each of the data structures.

In the conventional information backing up method as described above, since informations are backed up in the form of binary data which is the same as the form of internal information of the device, when the information form of informations is changed or the memory allocation is changed by version-up of the firmware of the device side, the backed up data may not possibly be used any more.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an internal information backing up device and method as well as a storage medium having an internal information backup control program stored thereon, in which the problem described above can be eliminated and, even if the form of information is changed or the memory allocation is changed by version-up of a firmware, the data structures of the informations can be corrected automatically.

The above object of the invention can be attained by an internal information backing up device for backing up a plurality of informations necessary for a firmware, which is incorporated in an electronic apparatus to control the operation of the electronic apparatus, which comprises a non-volatile storage medium including holding means for separately backing up the plurality of groups of informations having the same data structures and data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of the holding means

and version information at least representative of order of production of the setting informations, a volatile storage medium for holding the plurality of groups of informations having the same data structures, a data structure table disposed in the firmware for storing the information representative of the data structures of each of the plurality of groups of informations and the version information representative at least of the order of production of the informations of the volatile storage medium, expansion means for expanding the data structures of each of the plurality of groups of informations into the volatile storage medium based on the stored contents of the data structure table when the electronic apparatus is started, comparison means for comparing the version information stored in the data structure storage means of the non-volatile storage medium and the version information stored in the data structure table with each other for each of the plurality of informations, and writing means for writing, after the expansion of the data structures of each of the plurality of groups of informations into the volatile storage medium by the expansion means is completed, those of the setting information, in which coincidence is detected by the comparison means, into the volatile storage medium.

The above object of the invention can be attained also by an internal information backing up method for backing up a plurality of groups of informations necessary for a firmware, which is incorporated in an electronic device and controls operation of the electronic device, comprising a step of expanding, upon starting of the electronic device, based on information representative of data structures of each of the plurality of groups of informations stored in the firmware and version information at least representative of orders of production of the informations, the data structures of each of the plurality of setting informations into a volatile storage medium for holding each of the plurality of groups of informations each having the same data structures, a step of comparing version information stored in a non-volatile storage medium including a holding means for backing up the plurality of groups of informations having the same data structures and a data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of the holding means and version information at least representative of order of production of the informations, the data structure storage means and the version information stored in the firmware for each of the plurality of groups of informations, and a step of writing, after the expansion of the data structures of each of the plurality of groups of informations into the volatile storage medium, those of the setting informations in which coincidence is detected by the comparison into the volatile storage medium.

The above object of the invention can be attained also by providing a recording medium having stored thereon an internal information backing up control pro-

gram for backing up a plurality of informations necessary for a firmware, which is incorporated in an electronic device and controls operation of the electronic device, and the internal information backing up control program causes a control means, which controls the backing up of the informations, to expand, upon starting of the electronic apparatus, based on the information representative of data structures of each of the plurality of groups of informations stored in the firmware and version information at least representative of order of production of the informations, the data structures of each of the plurality of informations into a volatile storage medium for holding each of the plurality of groups of informations each having the same data structures, to compare version information stored in a non-volatile storage medium including holding means for backing up the plurality of informations having the same data structures and data structure storage means for storing information representative of the data structures of each of the plurality of setting informations of the holding means and version information at least representative of orders of production of the setting informations, the data structure storage means and the version information stored in the firmware for each of the plurality of groups of informations, and to write, after expanding the data structures of each of the plurality of setting informations into the volatile storage medium, those of the setting informations, in which coincidence is detected by the comparison, into the volatile storage medium.

In the internal information backing up method of the present invention, information representative of data structures of internal informations in the form of binary data delimited in a fixed unit and version information for the individual data structures are stored into tables provided in a firmware and a non-volatile RAM (non-volatile storage medium) in advance, and upon starting of the device, the data structures stored in the table of the replaced firmware are expanded into a RAM (volatile storage medium) so that the data structures prior to the replacement are changed into the new data structures of the replaced firmware.

Thereafter, only those of the internal informations in which version information stored in the table of the non-volatile RAM and version information stored in the table of the firmware coincide with each other are written into the RAM. For those of the internal informations in which the version information does not coincide with each other, default values (provisional values) which are written when the data structures are expanded into the RAM are maintained.

Consequently, even if the information form of the internal informations is changed or the memory allocation is changed by version-up of the firmware, the backed up internal informations can still be used.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a construction of

an embodiment of the present invention;

Fig. 2 is a diagrammatic view showing a construction of a backup data element of Fig. 1;

Fig. 3 is a diagrammatic view showing a construction of a data structure table of Fig. 1;

Fig. 4 is a flow chart illustrating processing operation of a backup data expansion processing element of Fig. 1; and

Fig. 5(a) is a diagrammatic view illustrating an example of a change of the memory allocation of internal informations according to the embodiment of the present invention and Fig. 5(b) is a diagrammatic view illustrating an example of a change of the information form of internal informations according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention is described with reference to the accompanying drawings. Fig. 1 is a block diagram showing a construction of the embodiment of the present invention. Referring to Fig. 1, device (electronic apparatus) 1 includes a firmware (FW) 2, non-volatile RAM (random access memory) 5, and RAM 8. A non-volatile storage medium may be used in place of non-volatile RAM 5 and a volatile storage medium may be used in place of RAM 8.

Firmware 2 includes a data structure table 3 for storing version information representing data structure of internal information, which is expanded in RAM 8 at the start of the device (information needed for operation of firmware 2, e.g. route information of input/output and initial value, and the order of production of internal information, a backup data expanding unit 4 for expanding backup data of internal information in RAM 8 based on the stored contents of the data structure table 3, and a default value storage unit 10 for storing beforehand default values (provisional value). It is to be noted that the firmware 2 operates based on a program read out from a main storage device or an external store (not shown) and internal informations of RAM 8.

The non-volatile RAM 5 includes a data structure table 6 for storing, when firmware 2 is to be replaced, version information, representing data structure of internal information, which is expanded in RAM 8 prior to the replacement of firmware 2 and the order of production of internal data, and a backup data element 7 for backing up backup data expanded in RAM 8. And RAM 8 includes a backup data element 9, in which internal information is expanded.

Fig. 2 is diagrammatic view showing a construction of backup data elements 7 and 9 of Fig. 1. Referring to Fig. 2, in each of backup data elements 7 and 9, internal information is stored in lumps for each of entities of data having the same data structures, in short, in the form of binary data delimited for each fixed unit. For example, a

group of data structures A includes entities A1 to Am of data stored in a lump, and other group of data structures B includes entities B1 to Bn of data stored in a lump.

Here, the internal informations represents set values necessary for operation of device 1 and is information needed to restore a condition of device 1 before the power supply is turned off, when the power supply to device 1 is turned off once and then turned on again.

Further, the entity of each data is formed from a plurality of labels. For example, entity A1 of data in the group of data structures A is formed from labels A1R1 to A1Rk. A label indicates a name applied to a package, for example, when 10 packages are mounted in a certain device, name is given to each of the 10 packages. In this instance, the structure of information that each package has is defined by a data structure while the type of the data is defined by the label, and the entity of the label represents values of data when the data structure is applied to the actual device.

Fig. 3 is a diagrammatic view showing a construction of data structure table 6 of Fig. 1. Referring to Fig. 3, data structure table 6 is composed of versions (indicating orders of production), sizes (memory sizes when expanded) and default values (provisional values) of labels A1R1 to A1Rk, ..., B1R1 to B1Rl, ... of entities A1 to Am, B1 to Bn, ... of the data of data structures A, B, ..., and has label numbers for individual entities A1 to Am, B1 to Bn, ... of the data of data structures A, B, ... as information.

Fig. 4 is a flow chart illustrating processing operation of the backup data expansion processing element 4 of Fig. 1, and Fig. 5(a) is a diagrammatic view illustrating an example of a change of the memory allocation of internal information according to the embodiment of the present invention while Fig. 5(b) is a diagrammatic view illustrating an example of a change of the information form of internal information according to the embodiment of the present invention. Operation of the embodiment of the present invention is described with reference to Fig. 1 to Figs. 5(a) and 5(b).

When firmware 2 whose form of backup data has been changed by version-up of the firmware is started, backup data expansion processing element 4 of firmware 2 starts an initialization operation (step S1 of Fig. 4) and expands, based on the stored contents of data structure table 3, all of the labels of data structures A, B, ... of data structure table 3 into backup data element 9 of RAM 8 (steps S2 to S4 of Fig. 4). Upon expansion of the data structures, the default values of default value storage element 10 are used for individual entities A1 to Am, B1 to Bn, ... of the data.

Then, backup data expansion processing element 4 resets its initial operation (step S5) and compares a version of data structure table 3 of firmware 2 with a corresponding version of data structure table 6 in non-volatile RAM 5 (version of a data structure of backup data element 7) (step S9 of Fig. 4).

Backup data expansion processing element 4

expands, if the versions coincide with each other, the backup data of backup data element 7, as it is, into RAM 8 (step S10), but if the versions do not coincide with each other, then backup data expansion processing element 4 maintains the corresponding default value of default value storage element 10. Backup data expansion processing element 4 repeatedly executes the processing described above for individual labels A1R1 to A1Rk, ..., B1R1 to B1Rl, ... of entities A1 to Am, B1 to Bn, ... of the data of data structures A, B, ... (steps S6 to S10 in Fig. 4).

After the expansion of all of the backup data into RAM 8 is completed, backup data expansion processing element 4 returns the backup data expanded in RAM 8 into backup data element 7 in non-volatile RAM 5 in which the backup data have been stored initially, and copies the stored contents of data structure table 3 in firmware 2 into data structure table 6 in non-volatile RAM 5.

When firmware 2 is started next time, since the contents in the element 7 have been updated to the data structure of firmware 2, correction of the backup data is not required.

Operation, for example, when, in backup data element 7 in non-volatile RAM 5, entity A1 of the data of data structure A is composed of labels A1R1 to A1R5, the information form of label A1R3, among labels A1R1 to A1R5, is changed, and besides label A1R6 is added, is illustrated in Fig. 5.

In this instance, into backup data element 9 of RAM 8, into which the data structures of new firmware 2 are to be expanded, the default values of default value storage element 10 are first written by the processing operation described above.

Then, since the versions of labels A1R1, A1R2, A1R4 and A1R5 in new firmware 2 and the versions of them in data structure table 6 in non-volatile RAM 5 are coincident with each other, the backup data of backup data element 7 in non-volatile RAM 5 are overwritten into the respective default values.

Since the version of label A1R3 in new firmware 2 does not coincide with the version in data structure table 6 in non-volatile RAM 5, the default value is maintained. Since information of label A1R6 is not included in data structure table 6 in non-volatile RAM 5, a default value is maintained. In this instance, in memory allocation of labels A1R4 to A1R6, they are allocated following label A1R3 whose size has been changed.

Since information representative of data structures of internal information of the binary form delimited in a fixed unit and versions of the individual data structures are stored into data structure tables 3 and 6 provided in firmware 2 and non-volatile RAM 5, respectively, and backup data expansion processing element 4 expands the data structures stored in data structure table 3 of exchanged firmware 2 upon starting of device 1, whereafter only internal information, in which the version in data structure table 3 of firmware 2 and the version in

data structure table 6 of non-volatile RAM 5 coincide with each other, is written into RAM 8, whereas the default value of internal information in which the versions do not coincide with each other, is maintained as described above, whereby data structure can be corrected automatically in accordance with the version of the internal information thereof. Consequently, even if the information form of an internal information is changed or the memory allocation is changed by version-up of firmware 2, the backed up internal informations can be used.

In the following, another embodiment of a backing up of the present invention is described.

The present embodiment is an internal information backing up device for backing up a plurality of informations necessary for a firmware, which is incorporated in an electronic device and controls operation of the electronic device, and comprises a non-volatile storage medium including a holding means for backing up the plurality of groups of informations each having the same data structures and data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of the holding means and version information at least representative of order of production of the informations, a volatile storage medium for holding the plurality of groups of informations each having the same data structures, a data structure table disposed in the firmware for storing the information representative of the data structures of each of the plurality of groups of informations and the version information representative at least of the order of production of the informations of the volatile storage medium, an expansion means for expanding the data structures of each of the plurality of groups of informations into the volatile storage medium based on the stored contents of the data structure table when the electronic device is started, a comparison means for comparing the version information stored in the data structure storage means of the non-volatile storage medium and the version information stored in the data structure table with each other for each of the plurality of groups of informations, and a writing means for writing, in which, after the expansion of the data structures of each of the plurality of groups of informations into the volatile storage medium by the expansion means is completed, those of the informations in which coincidence is detected by the comparison means into the volatile storage medium.

The present embodiment may be constructed such that it further comprises storage means disposed in the firmware for storing provisional values of the setting informations in advance, when the expansion means expands the data structures of each of the plurality of groups of informations into the volatile storage medium, and the provisional values stored in the storage means are written into the volatile storage medium.

Further, the present embodiment may be constructed such that it further comprises an updating

means for updating, in which after the writing of the information, in which coincidence has been detected by the comparison means, into the volatile storage medium by the writing means is completed, the stored contents of the holding means of the non-volatile storage medium are updated using the stored contents of the volatile storage medium and the stored contents of the data structure storage means of the non-volatile storage medium are updated using the stored contents of the data structure table.

Now, an embodiment of a backing up method of the present invention is described.

The present embodiment is an internal information backing up method for backing up a plurality of setting informations required to operate firmware, which is incorporated in an electronic device and controls operation of the electronic apparatus. The method comprises a step of expanding, when the electronic apparatus is started, based on information representative of data structures of each of the plurality of informations stored in the firmware and version information at least representative of order of production of the setting informations, the data structures of each of the plurality of groups of informations into a volatile storage medium for holding each of the plurality of groups of informations each having the same data structures, a step for comparing version information in a data structure storage means of a non-volatile storage medium including a holding means for backing up the plurality of groups of informations each having the same data structures and a data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of the holding means and version information at least representative of order of production of the informations, with the version information stored in the firmware for each of the plurality of groups of informations, and a step of writing, after the expansion of the data structures of each of the plurality of groups of informations into the volatile storage medium, those of the informations in which coincidence is detected by the comparison, into the volatile storage medium. And in the step of expanding the data structures of each of the plurality of informations may write provisional values of the setting informations stored in advance in the firmware may be written into the volatile storage medium when the data structures of the plurality of informations are expanded into the volatile storage medium. Further, the present method may further comprise a step, in which, after the writing of the information, in which coincidence has been detected, into the volatile storage medium is completed, the stored contents of the holding means of the non-volatile storage medium are updated using the stored contents of the volatile storage medium and the stored contents of the data structure storage means of the non-volatile storage medium are updated using the contents stored in the firmware.

Next, an embodiment of a storage medium of the

present invention is described.

The present embodiment is a storage medium storing thereon internal information backing up control program for backing up a plurality of internal informations necessary for a firmware, which is incorporated in an electronic device and controls operation of the electronic device, in which, the internal information backing up control program causes a control means, which controls the backing up of the informations, to expand, upon starting of the electronic device, based on information representative of data structures of each of the plurality of groups of informations stored in the firmware and version information at least representative of order of production of the setting informations, the data structures of each of the plurality of groups of informations into a volatile storage medium for holding each of the plurality of groups of informations each having the same data structures, to compare version information stored in the data structure storage means of a non-volatile storage medium including a holding means for backing up the plurality of groups of informations each having the same data structures and the data structure storage means for storing information representative of the data structures of each of the plurality of informations of the holding means and version information at least representative of order of production of the informations with the version information stored in the firmware for each of the plurality of setting informations, and to write, after the expansion of the data structures of each of the plurality of groups of informations into the volatile storage medium, those of the setting informations in which coincidence is detected by the comparison into the volatile storage medium. Further, in the storage medium, the internal information backing up control program may cause the control means to write provisional values of the informations stored in advance in the firmware into the volatile storage medium when the data structures of the plurality of informations are expanded into the volatile storage medium. Furthermore, the internal information backing up control program may cause the control means to update, after the writing of the setting information, in which coincidence has been detected, into the volatile storage medium is completed, the stored contents of the holding means of the non-volatile storage medium using the stored contents of the volatile storage medium and update the stored contents of the data structure storage means of the non-volatile storage medium using the stored contents stored in the firmware.

As described above, according to the present invention, upon starting of an electronic device, based on information representative of data structures of each of a plurality of groups of informations stored in a firmware and version information at least representative of order of production of the setting informations, the data structures of each of the plurality of groups of informations are expanded into a volatile storage medium for holding each of the plurality of groups of informations

each having the same data structures and then version information stored in a data structure storage means of a non-volatile storage medium including holding means for backing up the plurality of groups of informations each having the same data structures and data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of the holding means and version information at least representative of order of production of the informations, and the version information stored in the firmware are compared with each other for each of the plurality of groups of informations, whereafter those of the informations in which coincidence is detected by the comparison are written into the volatile storage medium after the expansion of the data structures of each of the plurality of groups of informations into the volatile storage medium is completed, and hence even if the information form of the setting informations is changed or the memory allocation is changed by version-up of the firmware, the data structures can be corrected automatically.

Claims

1. An internal information backing up device for backing up a plurality of groups of informations necessary for a firmware incorporated into an electronic apparatus to control the operation of said electronic apparatus, comprising:

a non-volatile storage medium including a holding means for separately backing up the plurality of groups of informations each having the same data structures and a data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of said holding means and version information at least representative of order of production of the informations,

a volatile storage medium for separately holding the plurality of groups of informations each having the same data structures,

a data structure table disposed in said firmware for storing the information representative of the data structures of each of the plurality of groups of informations and the version information representative at least of the order of production of the informations of said volatile storage medium,

an expansion means for expanding the data structures of each of the plurality of groups of informations into said volatile storage medium based on the stored contents of said data structure table when said electronic apparatus is started,

a comparison means for comparing the version information stored in said data structure stor-

age means of said non-volatile storage medium and the version information stored in said data structure table, with each other, for each of the plurality of groups of informations, and

a writing means for writing, after the expansion of the data structures of each of the plurality of groups of informations into said volatile storage medium by said expansion means is completed, those of the informations, with which coincidence is detected by said comparison means, into said volatile storage medium.

2. An internal information backing up device as claimed in claim 1, further comprising a storage means disposed in said firmware for storing provisional values of the informations in advance, wherein, when said expansion means expands the data structures of each of the plurality of groups of informations into said volatile storage medium, the provisional values stored in said storage means are written into said volatile storage medium.
3. An internal information backing up device as claimed in claim 1, further comprising an updating means for updating, after writing the information, with which coincidence has been detected by said comparison means, into said volatile storage medium by said writing means, the stored contents of said holding means of said non-volatile storage medium using the stored contents of said volatile storage medium and updating the stored contents of said data structure storage means of said non-volatile storage medium using the stored contents of said data structure table.
4. An internal information backing up device as claimed in claim 2, further comprising an updating means for updating, after writing the information, with which coincidence has been detected by said comparison means, into said volatile storage medium by said writing means, the stored contents of said holding means of said non-volatile storage medium using the stored contents of said volatile storage medium and updating the stored contents of said data structure storage means of said non-volatile storage medium using the stored contents of said data structure table.
5. An internal information backing up method for backing up a plurality of informations necessary for a firmware, which is incorporated into an electronic apparatus and controls operation of said electronic apparatus, comprising the steps of:

expanding, upon starting of said electronic apparatus, based on information representative of data structures of each of the plurality of

groups of informations stored in said firmware and version information at least representative of orders of production of the setting informations, the data structures of each of the plurality of groups of informations into a volatile storage medium for holding each of the plurality of groups of informations each having the same data structures,

comparing version information stored in a non-volatile storage medium including the holding means for separately backing up the plurality of groups of informations each having the same data structures and the data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of said holding means and version information at least representative of order of production of informations, with the version information stored in said firmware, for each of the plurality of groups of informations, and

writing the informations, in which coincidence is detected in the comparing steps, into the volatile storage medium after expanding the data structures of each of the plurality of groups of informations into the volatile medium.

6. An internal information backing up method as claimed in claim 5, wherein, in the step of expanding the data structures of each of the plurality of groups of informations, provisional values of the informations stored in advance in said firmware are written into said volatile storage medium when the data structures of the plurality of informations are expanded into said volatile storage medium.
7. An internal information backing up method as claimed in claim 5, further comprising a step of updating, after writing the setting information, in which coincidence has been detected, into said volatile storage medium, the stored contents of said holding means of said non-volatile storage medium using the stored contents of said volatile storage medium and updating the stored contents of said data structure storage means of said non-volatile storage medium using the stored contents stored in said firmware.
8. An internal information backing up method as claimed in claim 6, further comprising a step of updating, after writing the setting information, in which coincidence has been detected, into said volatile storage medium, the stored contents of said holding means of said non-volatile storage medium using the stored contents of said volatile storage medium and updating the stored contents of said data structure storage means of said non-volatile storage medium using the stored contents stored in

said firmware.

9. A recording medium having stored thereon an internal information backing up control program for backing up a plurality of informations necessary for a firmware, which is incorporated in an electronic apparatus and controls operation of said electronic apparatus, wherein

the internal information backing up control program causes a control means, which controls the backing up of the setting informations to expand, upon starting of said electronic apparatus, based on information representative of data structures of each of the plurality of groups of informations stored in said firmware and version information at least representative of order of production of the informations, the data structures of each of the plurality of groups of informations into a volatile storage medium for holding each of the plurality of informations for the individually same data structures to compare version information stored in the data structure storage means of a non-volatile storage medium including a holding means for backing up the plurality of groups of informations each having the data structures and data structure storage means for storing information representative of the data structures of each of the plurality of groups of informations of said holding means and version information at least representative of order of production of the setting informations, with the version information stored in said firmware for each of the plurality of informations, and to write, after the expanding the data structures of each ones of the plurality of groups of informations into said volatile storage medium, those of the informations, in which coincidence is detected by the comparison, into said volatile storage medium.

10. A recording medium having stored thereon an internal information backing up control program as claimed in claim 9, wherein the internal information backing up control program causes said control means to write provisional values of the setting informations stored in advance in said firmware into said volatile storage medium when the data structures of the plurality of groups of informations are expanded into said volatile storage medium.

11. A recording medium having stored thereon an internal information backing up control program as claimed in claim 9, wherein the internal information backing up control program causes said control means to update, after writing the information, in which coincidence has been detected, into said volatile storage medium, the stored contents of said holding means of said non-volatile storage medium using the stored contents of said volatile storage medium and to update the stored contents of said

data structure storage means of said non-volatile storage medium using the stored contents stored in said firmware.

12. A recording medium having stored thereon an internal information backing up control program as claimed in claim 10, wherein the internal information backing up control program causes said control means to update, after writing the information, in which coincidence has been detected, into said volatile storage medium, the stored contents of said holding means of said non-volatile storage medium using the stored contents of said volatile storage medium and to update the stored contents of said data structure storage means of said non-volatile storage medium using the stored contents stored in said firmware.

FIG. 1

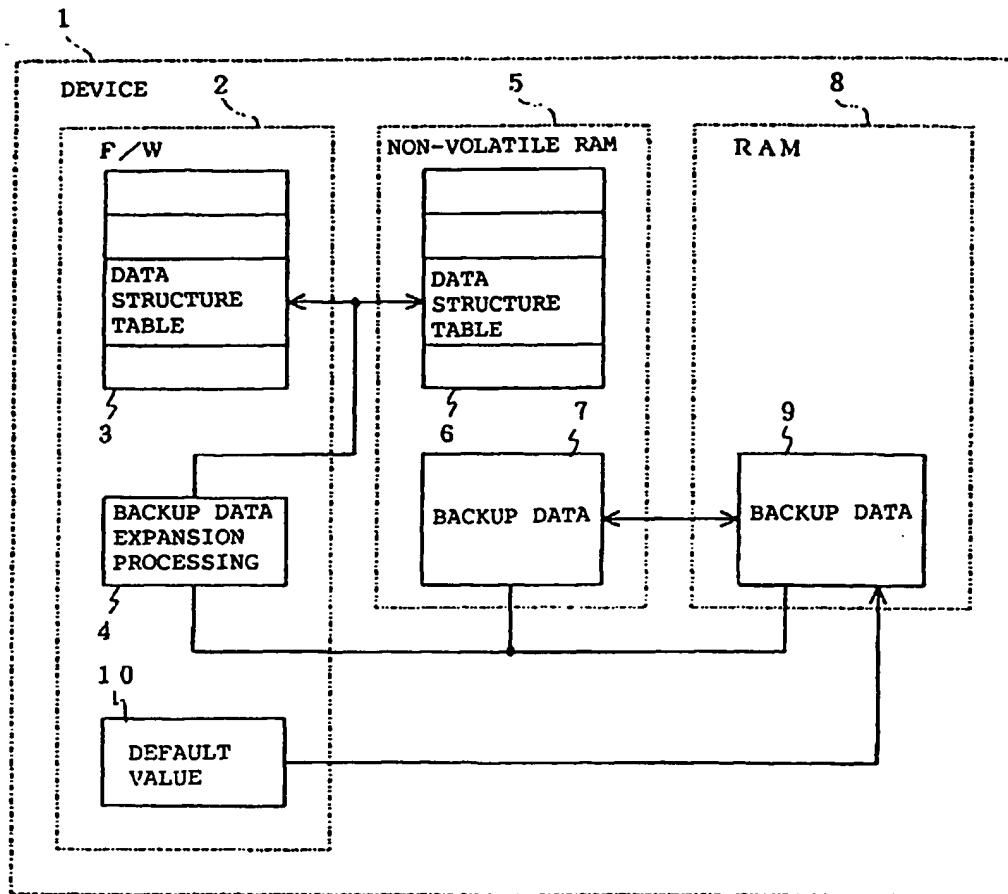


FIG. 2

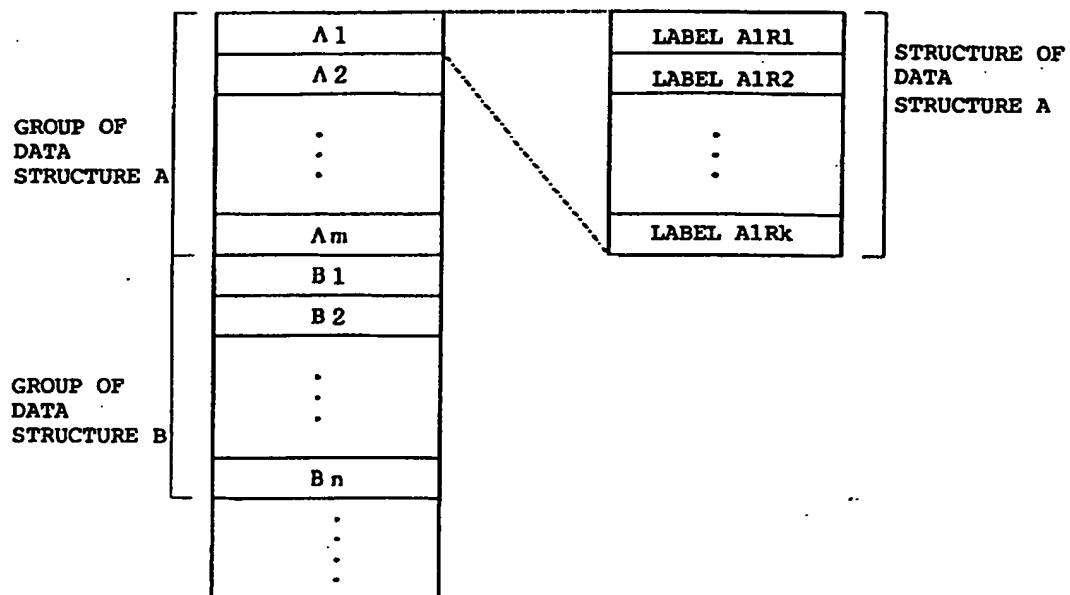


FIG. 3

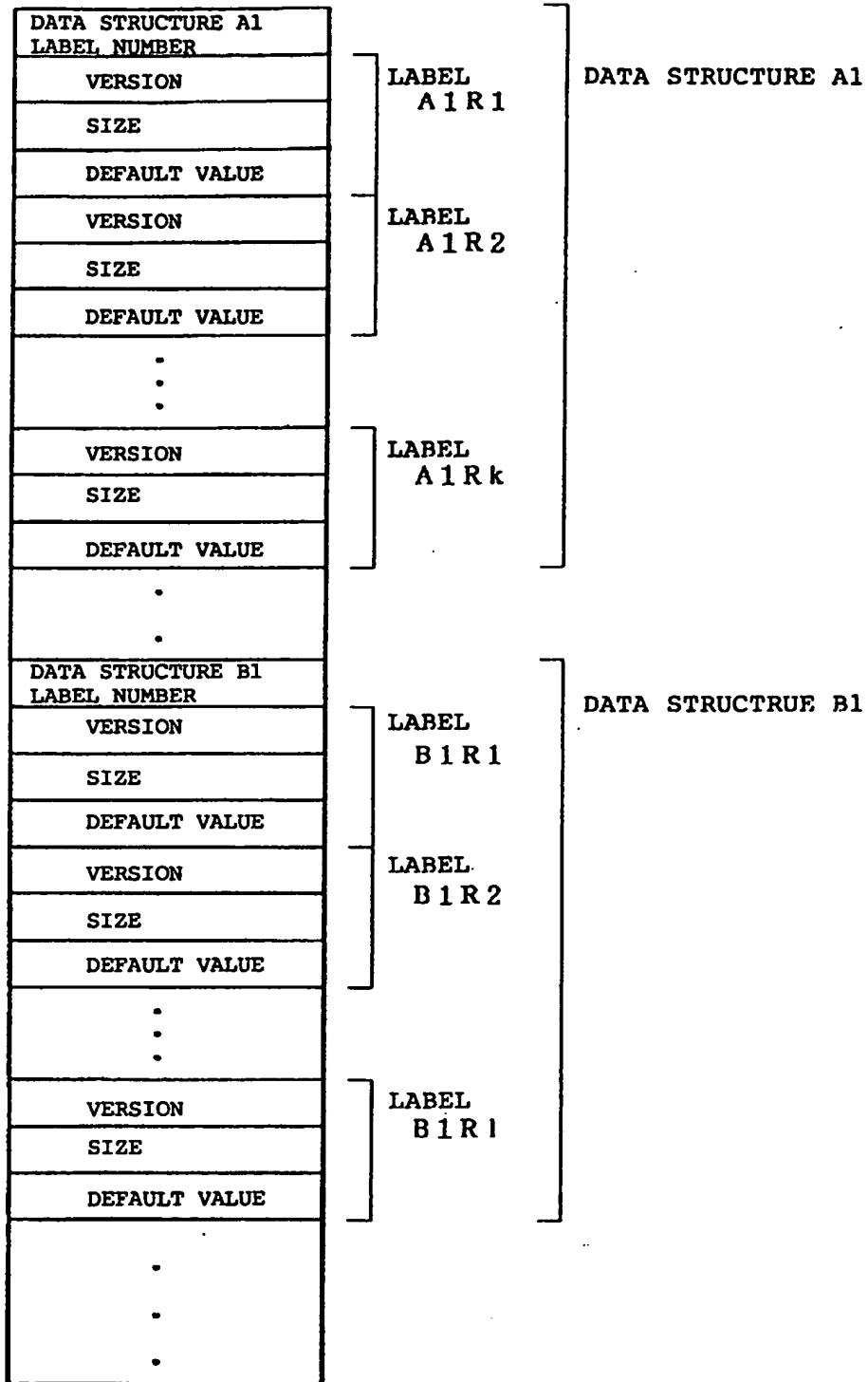


FIG. 4

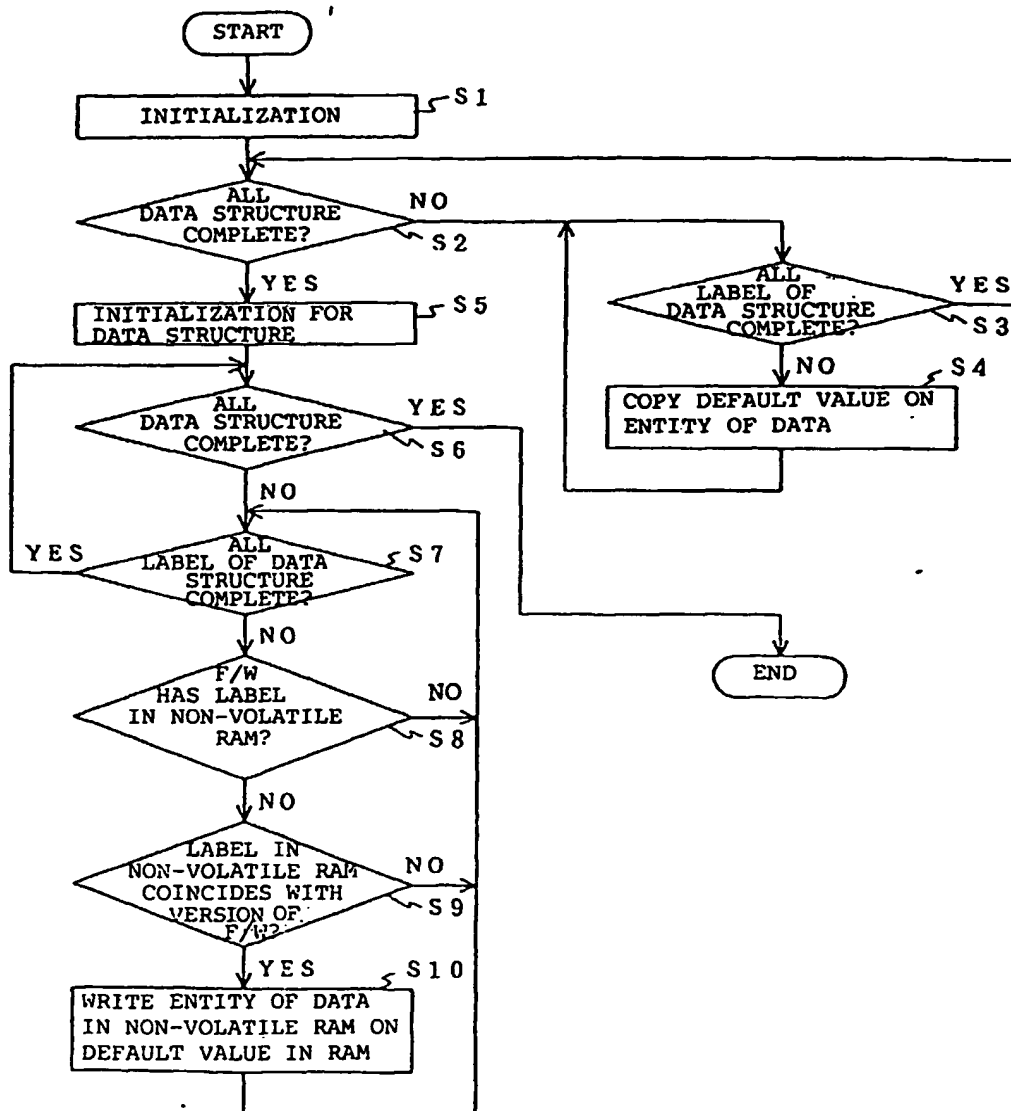


FIG. 5(a)

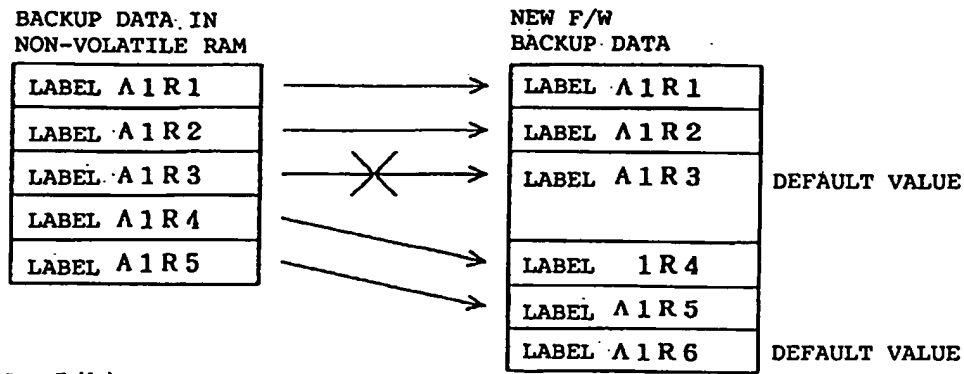


FIG. 5(b)

